



OPERATIONS MANUAL

QL40-XYCAL60: XY Caliper Probe



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2 GENERAL INFORMATION

QL40-XYCAL60 is a 4-arm caliper probe with two independent pairs of mechanically linked arms. The arms accurately measure borehole diameters using the two sets of perpendicular arms. The probe provides accurate measurements of the X and Y axis. Typically used in an open hole environment, the probe measures 2-channel (XY) continuous borehole diameter. The QL40-XYCAL probe can be operated in cased holes, water filled, and air-filled holes. The probe is commonly used for large municipality water wells, mineral logging, and engineering applications. The probe can locate cracks, fissures and casing defects.

The QL40-XYCAL60 is supplied with two different sets of arms. The standard arms are suitable for a borehole diameter ranging from 4.0 inches to 40 inches (10.16 cm to 101.6 cm). The longer arms are suitable for borehole diameters up to 60 inches (152.4 cm). The caliper arms can be unscrewed from their short pivot arms and may be replaced with ones of different lengths. The caliper arms have a carbide wear tip that can be unscrewed or easily replaced.

QL stands for Quick Link and describes the latest line of stackable logging tools. This development is a joint venture of Mount Sopris Instruments (MSI) and Advanced Logic Technology (ALT). Innovative connections between tool elements (subs) allow users to build their own tool strings.

The Tool Stack Factory – a sophisticated extension of the acquisition software – provides a convenient way to configure tool strings for operation.

Each sub has a Telemetry and Power Supply Unit (TelePSU) allowing them to operate in a stacked or individual configuration. The GenCPU card handles analog to digital conversion and/or counting of the measurement signal and data formatting for transmission up hole.

The QL40-XYCAL60 probe can be operated stand-alone or stacked with other QL family tools as a bottom sub.

2.1 Dimensions

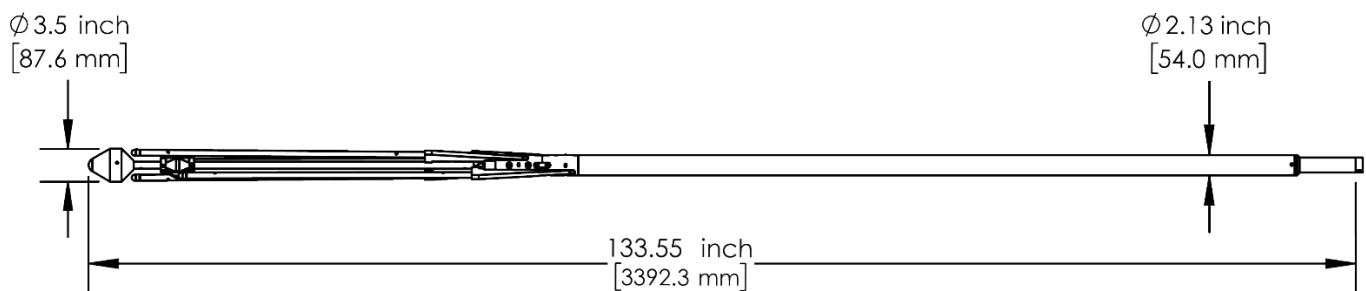


Figure 2-1 QL40-XYCAL60 Dimensions

2.2 Technical Specifications

Tool:

Housing Outer Diameter:	5.40cm (2.13in)
Arms Minimum Diameter:	8.38cm (3.30in)
Bullnose Diameter:	8.76cm (3.5in)
Length:	3.39m (133.55in)
Weight:	34kg (74lbs)
Maximum Temp:	70°C (158°F)
Maximum Pressure:	200bar (2900psi)

Cable:

Cable Type:	Mono, Coaxial, 4 conductor, 7 conductor
Digital Data Transmission:	Up to 500 Kbits per second depending on wireline and logger
Compatibility:	OPAL – SCOUT Pro – Matrix

Arm Extension Measurements:

Small Arm Extension:	Length: 10.2cm (4in) Calibrate between: 25.4 - 55.88cm (10 - 22in)
Medium Arm Extension:	Length: 101.6cm (40in) Calibrate between: 25.4 - 109.22cm (10 - 43in)
Large Arm Extension:	Length: 152.4cm (60in) Calibrate between: 25.4 - 152.4cm (10 - 60in)

Power:

DC Voltage at Probe Top:	Nominal 120VDC Min 80VDC Max 160VDC
Current:	Nominal 25mA

3 NOTES ON QL TOOL ASSEMBLY

QL stands for **Quick Link** and describes an innovative connection between logging tools (subs) allowing to build custom tool stacks. QL40 describes a specific family of logging tools. Each sub is equipped with its own telemetry board, power supply element and A/D converter allowing an operation as stand-alone tool or as a stack in combination with other subs of the QL product family.

The QL40 probe line deals with two types of subs - Bottom Subs and Mid Subs.

Bottom Sub

A bottom sub is a tool that must have one or more sensors located at the bottom. It can be operated in combination with other QL subs connected to the top, but it is not possible to connect another sub below. When used in stand-alone mode the bottom sub only needs a QL40 tool top adaptor, which fits the cable head. The QL40-XY60 probe is a bottom sub.

Inline Sub

Inline subs can be integrated anywhere within a stack of tools. When used at the bottom of a tool string a QL40 bottom plug must be used to terminate the string. If the mid sub is used as a stand-alone tool, it needs a QL40 bottom plug at the lower end and a QL40 tool top adaptor at the top.

3.1 QL40 stack assembly

QL40 tool stacks need a QL40 tool top to connect to the cable head and a QL40 bottom plug *or* a QL40 bottom sub to terminate the stack. There are several tool tops available to accommodate standard cableheads such as the QL40-MS1, QL40-GO4, QL40-GO7 and others. Special subs can be made on request.

To assemble and disassemble subs, use the C-spanner delivered with the QL tools (Figure 3-1). We recommend that before each assembly the integrity of the O-rings (AS216 Viton shore 75) is verified. Prime the O-rings with the silicon grease that was supplied with the subs.

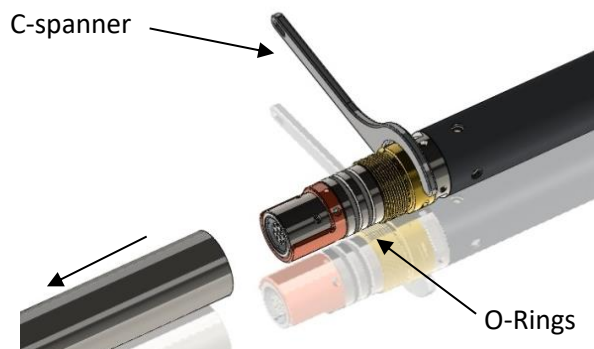


Figure 3-1 C-spanner and O-rings of QL connection

The following example of a QL40-XYCAL60, QL40-GR and QL40-GO4 (Figure 3-2) describes how to attach the QL40-GR to a QL40-XYCAL60 to run the subs as a stack.

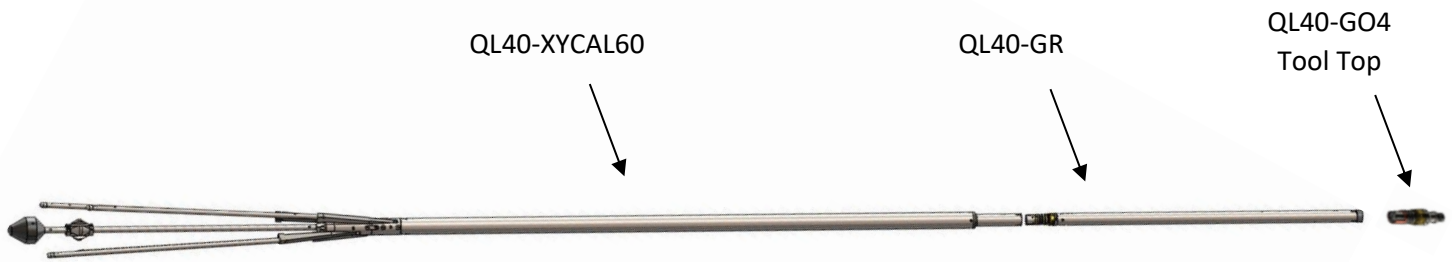


Figure 3-2 Tool stack example

To attach the QL40-XYCAL60 bottom sub use the C-spanner to the threaded ring as shown in Figure 3-3.

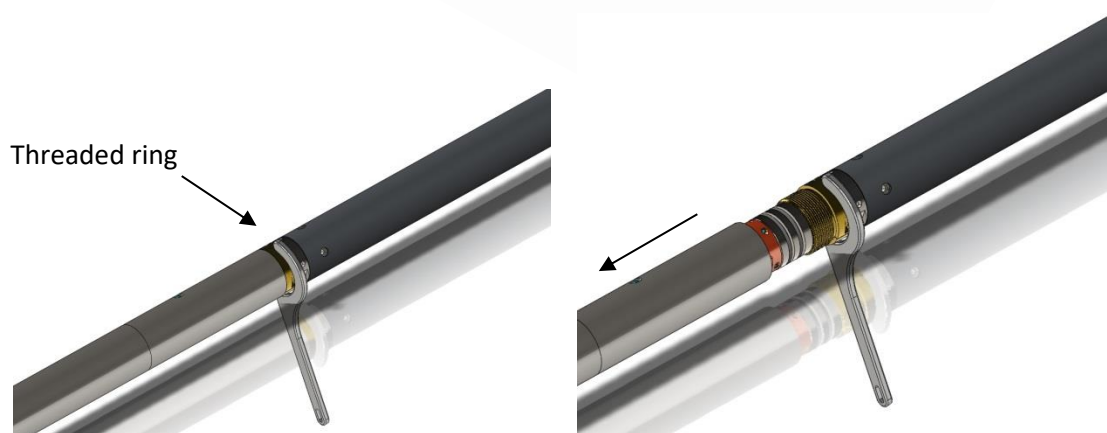


Figure 3-3 Unscrewing the threaded ring and removing the bottom plug

Always check the O-ring integrity then slip the QL40-XYCAL60 top end over the exposed lower portion of the QL40-GAM connector and attach using the C-spanner to twist the threaded ring until tightened. Do the same for the probe top that will attach to the cablehead. The subs can now be run as a stack.

4 OPERATING PROCEDURE

Note: Parts of the topics discussed in these sections below assume the user is familiar with Logger Suite acquisition software. Refer to the corresponding operator manuals for more details. Information about assembly and configuration of tool stacks can be found in the same manuals.

4.1 Quick Start

1. Connect the QL40-XYCAL60 to your wireline and open the Logger Application.
2. Select the relevant QL40-XYCAL60 tool/stack from the drop-down list (Figure 4-1.1) in the software's **Tool** panel (if your tool is not listed check that your tool configurations file is stored in the designated folder on your computer using the *Logger Settings* application).
3. In the **Tool** panel switch on the tool (click **On** button) and verify that the power indicator shows a valid (green) level. The system goes through a short initialization sequence which sets the default parameters and communication settings held in the tool configuration file. The configuration returned by the tool is also checked during this procedure. (Setup tool communication is explained in Chapter 4.2 if an error message is displayed)
4. In the **Acquisition** panel (Figure 4-1.2) select the time sampling mode. Switch on the sampling (click the **ON** button).
5. On the **Tool** panel (Figure 4-1.1) click the **Settings / Commands** button and open the caliper arms from the **Caliper operations** dialog box (Figure 4-1.4).
6. Once the caliper arms are open (Caliper Operating progress bar disappeared) turn the sampling **Off**, select the final sampling mode (depth or time) from the **Acquisition** panel (Figure 4-1.2). Click on **Settings** and specify the corresponding sampling rate. Switch on the sampling again (click the **ON** button).
7. Press the **Record** button in the **Acquisition** panel (Figure 4-1.2) specify a file name and start the logging.
8. During logging observe the controls in the **Telemetry** panel (Figure 4-1.3):
 - ✓ Status is valid (green light).
 - ✓ Bandwidth usage in green range.
 - ✓ Memory buffer should be 0%.
 - ✓ Number of **Data** should increase.
 - ✓ Should be very few **Errors**.
9. To end the logging procedure, press the **Stop** button in the **Acquisition** panel and turn off the sampling (click **OFF** button).
10. On the **Tool** panel (Figure 4-1.1) click the **Settings / Commands** button and close the caliper arms from the **Caliper operations** dialog box (Figure 4-1.4).
11. Once arms are fully closed in the **Tool** panel, power off the tool.

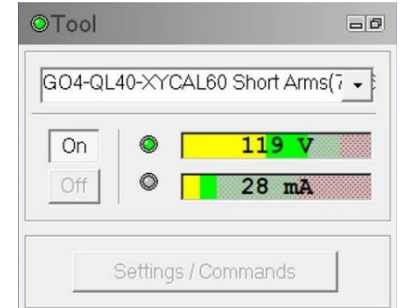


Figure 4-1.1 Tool panel

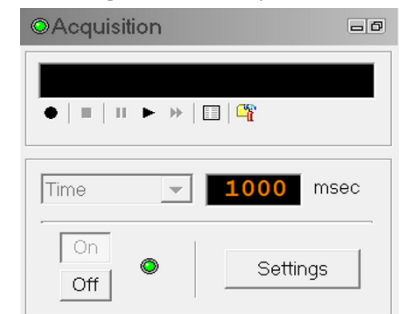


Figure 4-1.2 Acquisition Panel

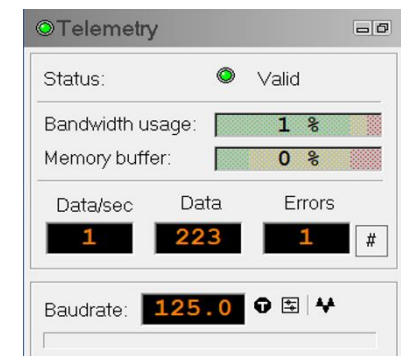


Figure 4-1.3 Telemetry Panel

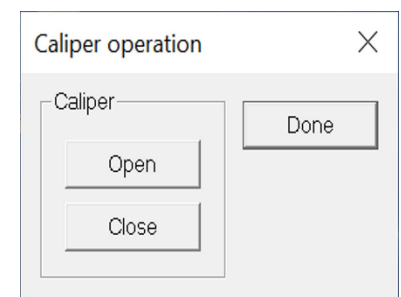


Figure 4-1.4 Caliper Operation

4.2 Tool Communication with ALT Logger

Telemetry provided through the Logger Suite is self-tuning. In case the communication status is not valid the user can manually adjust the settings. In the **Telemetry** panel of the dashboard click on **Settings** to display the **Configure Tool Telemetry** dialog box (Figure 4-2).

A procedure to achieve valid communication is given below:

- Change the **Baudrate** to 41666 kbps as a starting point.
- Verify that the **Downhole Pulse width** knob is set on 20 (default value). This value is the preferred one and is suitable for a wide range of wirelines. For long wireline (over 2000m), increasing the pulse width could help to stabilize the communication. The reverse for short wireline (less than 500m).
- Set the **Uphole Discriminators** in the middle of the range for which the communication status stays valid.
- Increase the **Baudrate**, check the communication status stays valid and the **Bandwidth usage** (in **Telemetry** panel of the dashboard) is below the critical level.
- When **Uphole Discriminators** are properly set, store the new configuration as default. The tool should go through the initialization sequence the next time it is turned on.

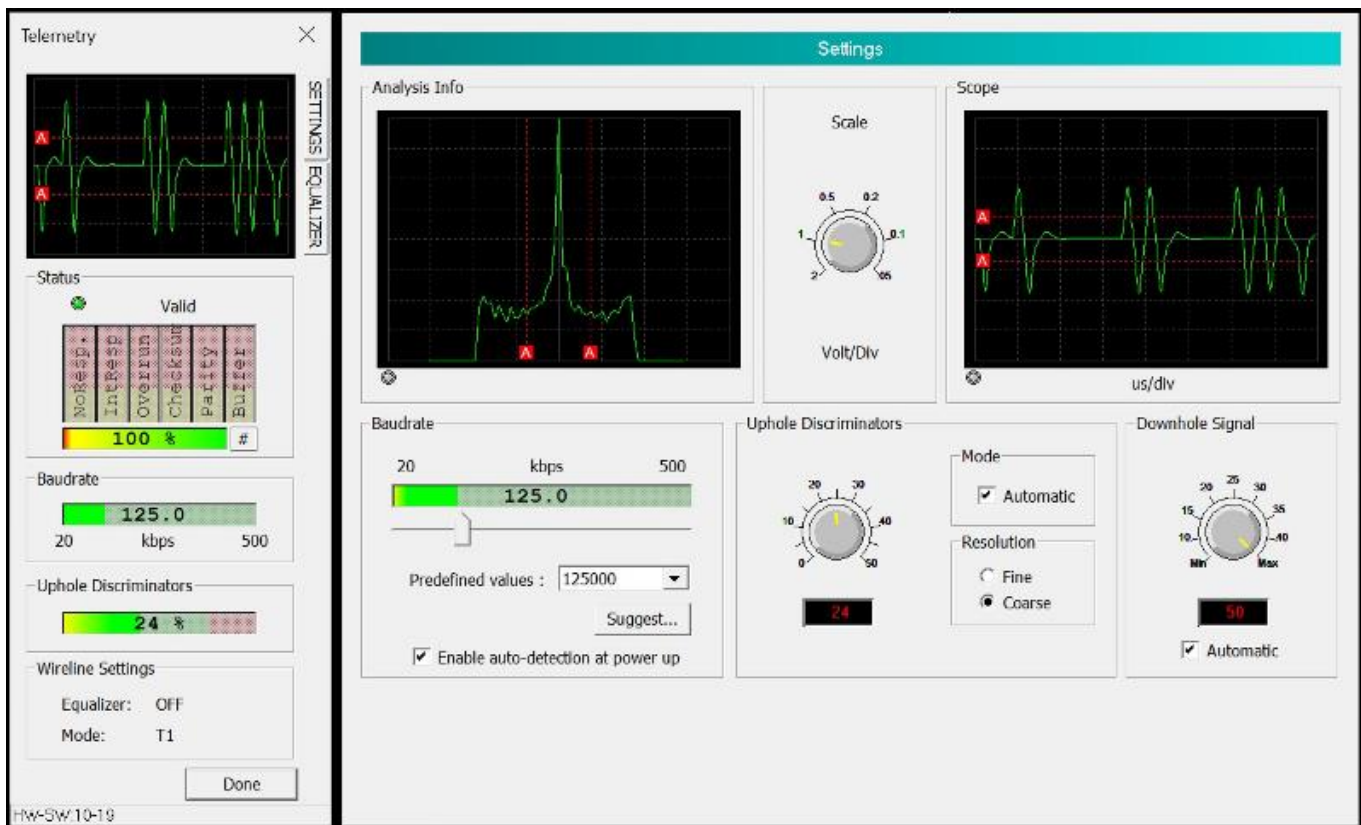


Figure 4-2 Tool communication settings

4.3 Tool Communication Settings

The tool telemetry **Settings** provide various controls to adjust the telemetry settings and monitor its status.

The **Analysis View** displays the current discriminator levels (vertical red lines) and a histogram of the up-hole data signal. The scales of the **Analysis View** can be adjusted using the **Vertical Scale** and **Horizontal Scale** knobs and the **linear / logarithmic** scale buttons.

The status of the configuration should be flagged as Valid (indicated by the LED being green). In any other case (LED red) the telemetry should be adjusted (we assume a pulse signal is displayed in the analysis view). Click on the **Advanced** button to display additional controls to tune the telemetry.

The Automatic settings option is the preferred mode and should allow the telemetry to be configured for a wide range of wirelines without operator input. For wirelines with a more limited bandwidth, the operator might need to turn off the automatic mode and adjust the telemetry settings manually.

For each wireline configuration, the discriminators (vertical red lines) for the **positive** and **negative** pulses must be adjusted in order to obtain a valid communication status (see Figure 4-2 for an example of a suitable discriminator position). There is also the option to alter the **baudrate** to optimize the logging speed. The input **gain** can be increased (long wirelines) or decreased (short wirelines) to set up the discriminator levels correctly.

Once the telemetry is correctly set, store the new settings as default. The tool should go through the initialization sequence in "Valid" status the next time the power is turned on.

4.4 Operating the Tool

Warning: *Never lower the tool down the hole with caliper arms open!*

Once the tool has been lowered down to the start position in the hole it is recommended to turn on the sampling in time mode first before opening the caliper arms. This will display the MChNum browser window and allows monitoring of the caliper arm opening progress.

Arm Extension Process Prior to Logging:

- Ensure the tool is powered on.
- Select **Acquisition Panel > Time**.
- Start the sampling (**Acquisition Panel > On**). The MChNum browser window (Figure 4-4.1) will open.



Figure 4-4.1 MChNum window

Now open the caliper arms using **Tool Panel > Settings / Commands > Caliper Operation > Open** (Figure 4-4.2).

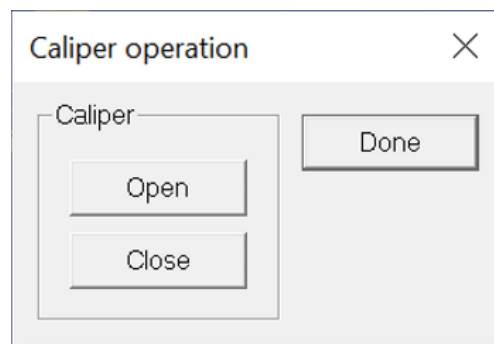


Figure 4-4.2 XY Caliper operation dialog to open/close the caliper arms

During the process of opening/closing the caliper arms the status bar shown in Figure 4-4.3 will be displayed.

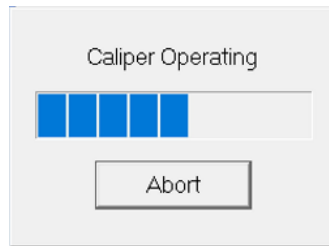


Figure 4-4.3 Caliper Operating progress bar

During operation of the motor to open/close the caliper arms increased power consumption can be observed in the **Tool Panel** (Figure 4-4.4).

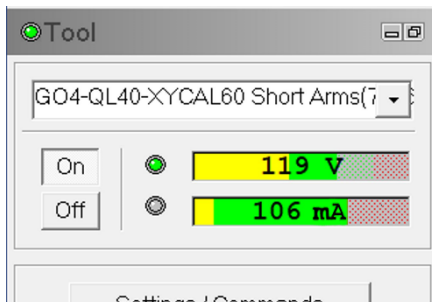


Figure 4-4.4 Increased power consumption during opening and closing

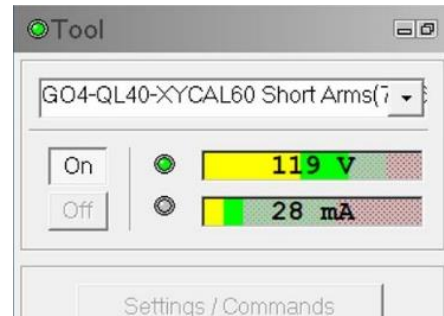


Figure 4-4.5 Nominal power consumption when caliper motor is not operating

One should wait until the motor has fully opened the caliper arms before commencing the logging operation. This is the case when the **Caliper Operating** status bar (Figure 4-4.3) has disappeared, and the power consumption should fall back to the nominal value (Figure 4-4.5). Logging up the borehole can begin.

4.5 MChCurve Browser and Recorded Parameters

The QL40-XYCAL60 produces two channels which are displayed as curves in the MChCurve browser window (Figure 4-5.1).

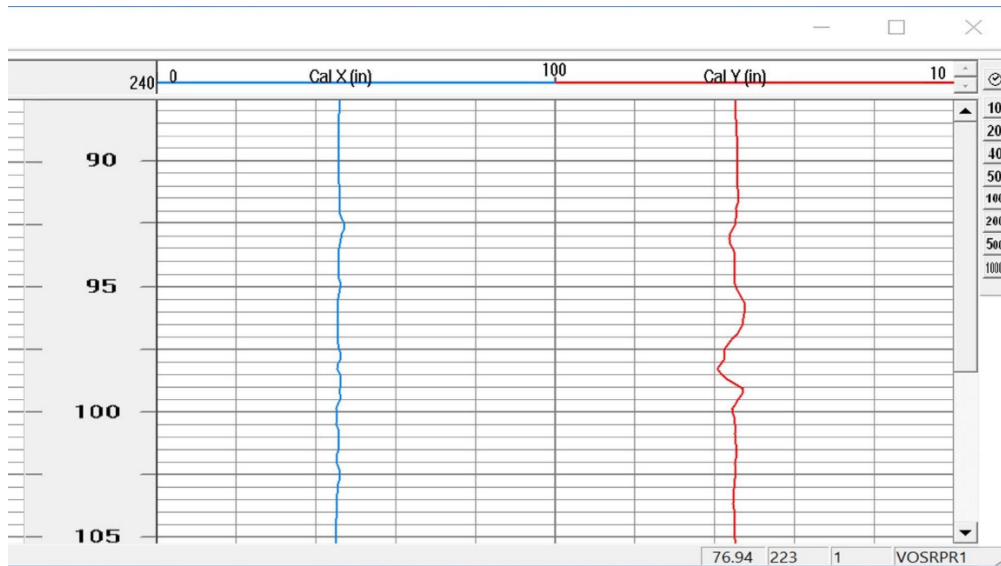


Figure 4-5.1 MChCurve browser window displaying Caliper curve

The user can modify the curve presentation (colors, column position, scale, filter, gridding, name, line style...)

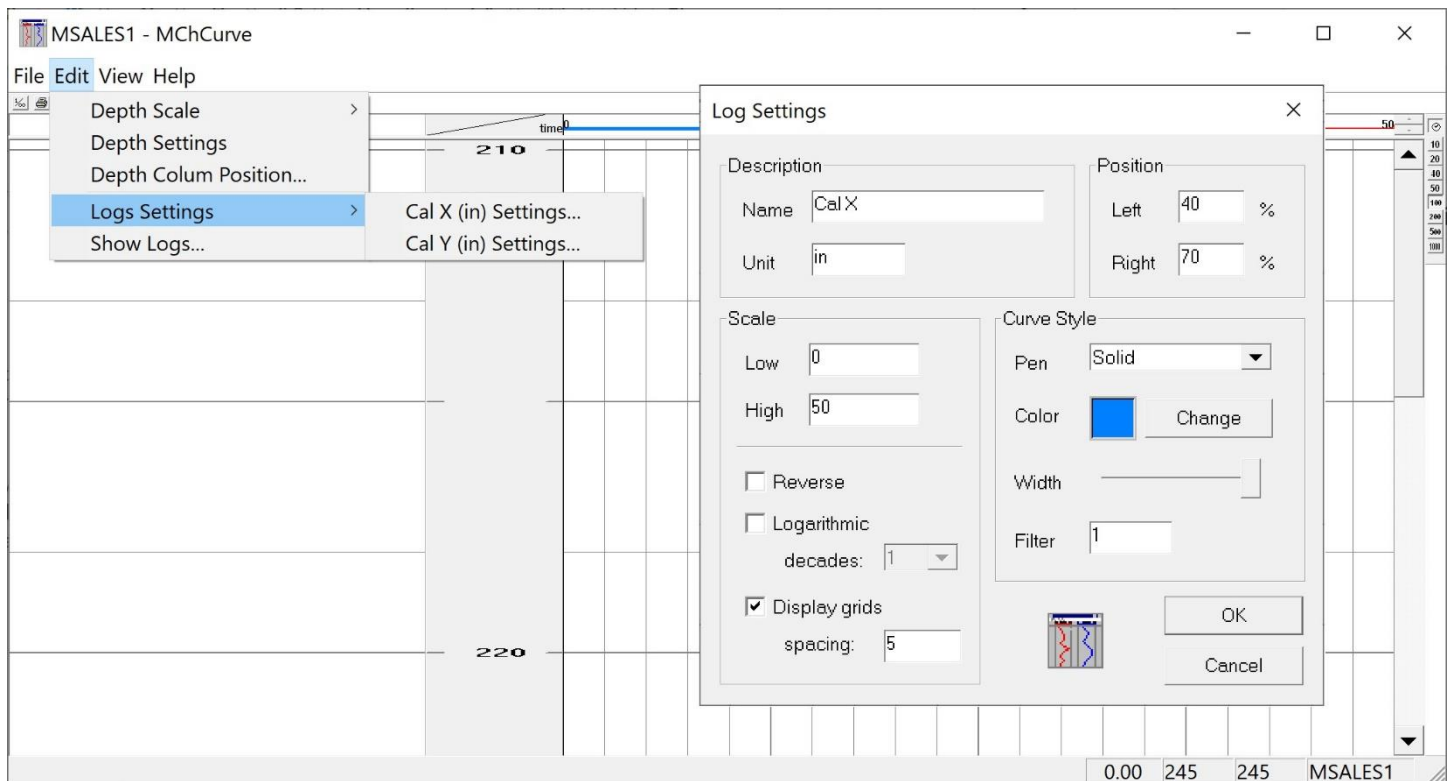


Figure 4-5.2 MChCurve log settings

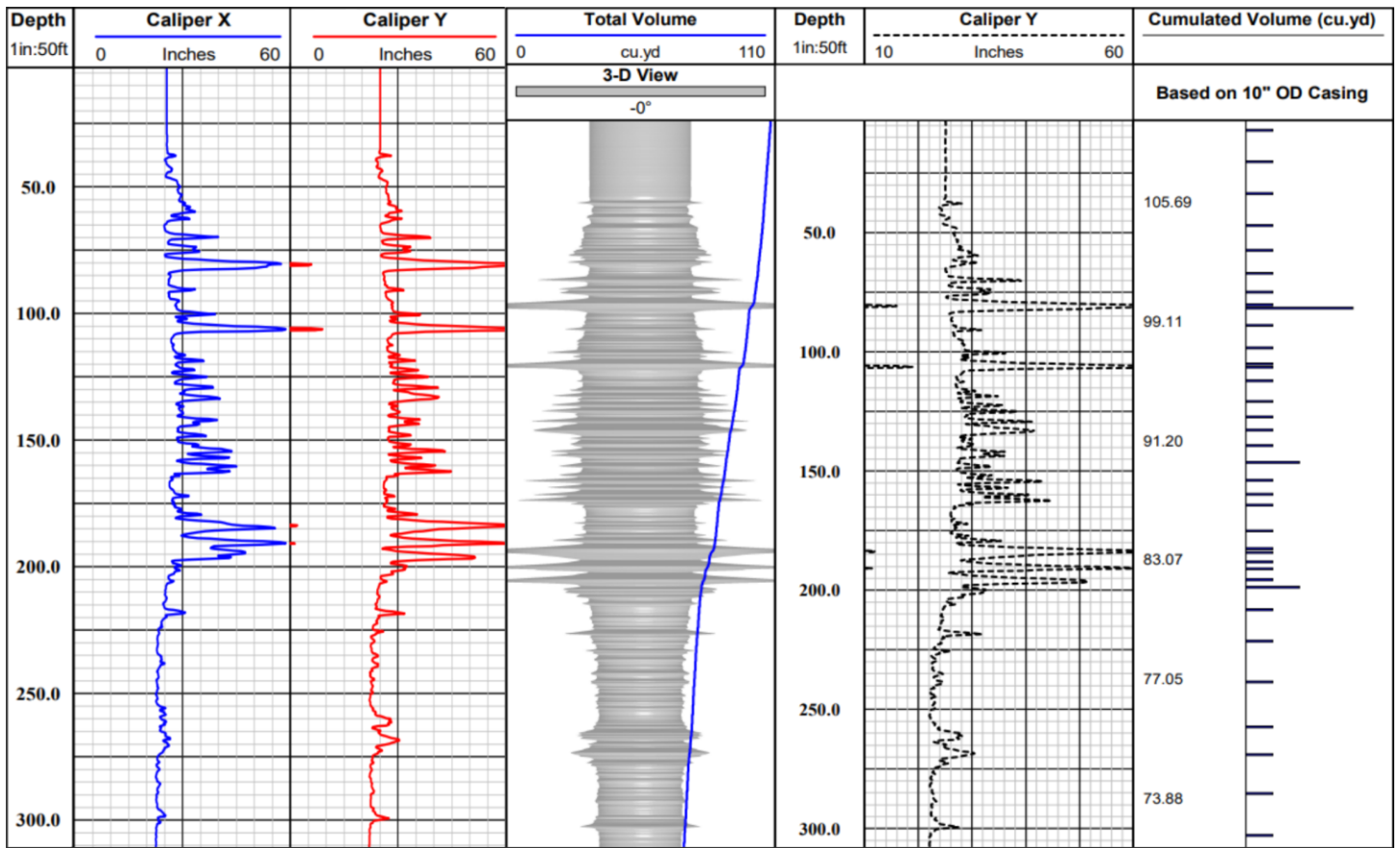


Figure 4-5.3 A sample of the data taken by the probe

5 CALIBRATION & PERFORMANCE CHECK

Sub files are sent to the customer already calibrated for standard arm lengths. If necessary, calibration can also be done by the customer using calibration lengths of a known distance over the opened arms. The Field Calibration Kit (part number: 2000-2747) shown in Figure 5-1.1 is sold separately.



Figure 5-1.1 Using the Field Calibration Kit

Prepare to Calibrate:

1. Assemble the tool sub(s) and connect to the wireline.
2. In the **Tool Panel**:
 - a. Select the proper tool/stack.
 - b. Turn tool power **On**.
 - c. Click Tool Panel **Settings/Commands** button and open the caliper arms.
3. Assemble the Field Calibration Kit by inserting the rods through the extension constraint clamps. Measure the distance between the measurement edges and lock the clamps in place by tightening the screws with a M5 Hex key.
4. Slide the calibration jig over the body of the tool from the bottom and with the arms opened place a pair of arms into the sockets (Figure 5-1.1).
5. In the **Acquisition Panel** select **Time** and turn it **On**.
6. Click the Green LED at the top left corner of the MCHNum Browser window or right click the top pane to display the MCHNum context menu (Figure 5-1.2).
7. Select **Calibration Settings**.

CAUTION

When compressing the caliper arms for calibration, it is possible for the arms to slip out of the socket and strike the user

8. Calibration Settings

1. There are **TWO** calibration pages, one for Cal X and another for Cal Y. Check the letters stamped into the housing by the arm joints (Figure 6-2) and check you are entering the calibration data for the correct arms.
2. In the First Point **Reference** cell enter the diameter of the smallest calibration value (minimum of 4in or 10.16 cm).
3. To **Sample** the information, click the ellipsis (...) button that appears after selecting the adjacent value cell. Wait until the sampling is complete and an average value has been displayed in the **Value** box.

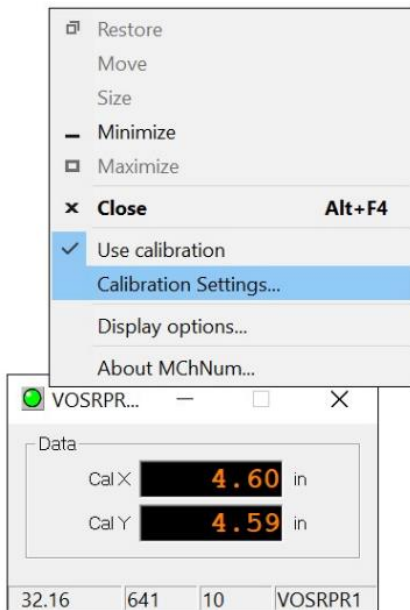


Figure 5-1.2 MCHNum context menu

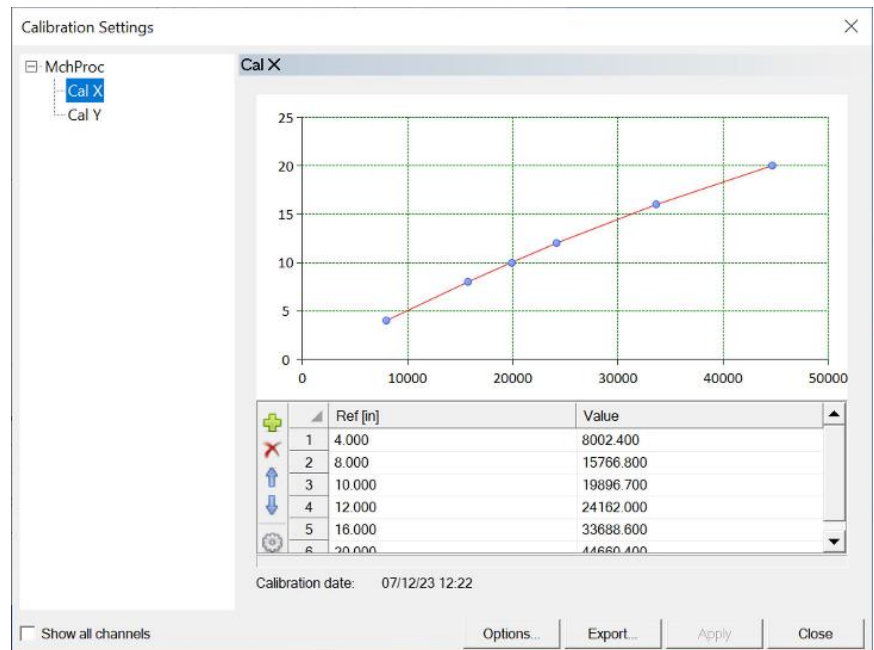


Figure 5-1.3 Calibration Settings

4. For the remaining rows in the table:
 - a. Adjust the calibration jig's diameter a few inches wider.
 - b. Enter the new diameter into the next **Reference** cell.
 - c. Sample the information in the adjacent **Value** cell.

(The number of samples taken can be changed in **Options**.)
5. If correctly calibrated the points should form a nearly straight line on the graph (Figure 5-1.3).
6. Click **Apply** to update the corresponding sub files followed by **Close**.
7. Click the Green LED at the top left corner of the MCHNum Browser window or right click the top pane to display the MCHNum context menu (Figure 5-1.2). This time click **Use Calibration**.

6 MAINTENANCE

Warning: Removing the electronic chassis from pressure housing without prior consultation with the manufacturers may void the tool warranty.

Basic maintenance is required on the caliper tool. It will consist mainly in keeping the tool clean and in good operating conditions.

For the ease of caliper arm replacement, it is recommended to prime the caliper arm threads with mechanical grease or anti-seize.

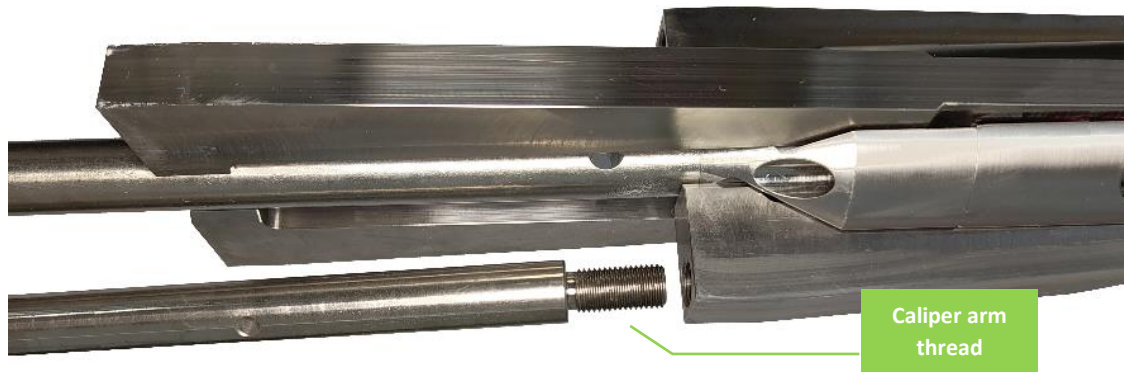


Figure 6-1 Caliper arm thread

To prevent any intrusion of dirt and grit into the caliper rack assembly it is good practice to fill the inside with silicone grease (Molykote 111 compound silicon grease or equivalent such as Red N Tacky grease).

The grease zerks on the caliper arm assembly are the grease injection points (Figure 6-2).

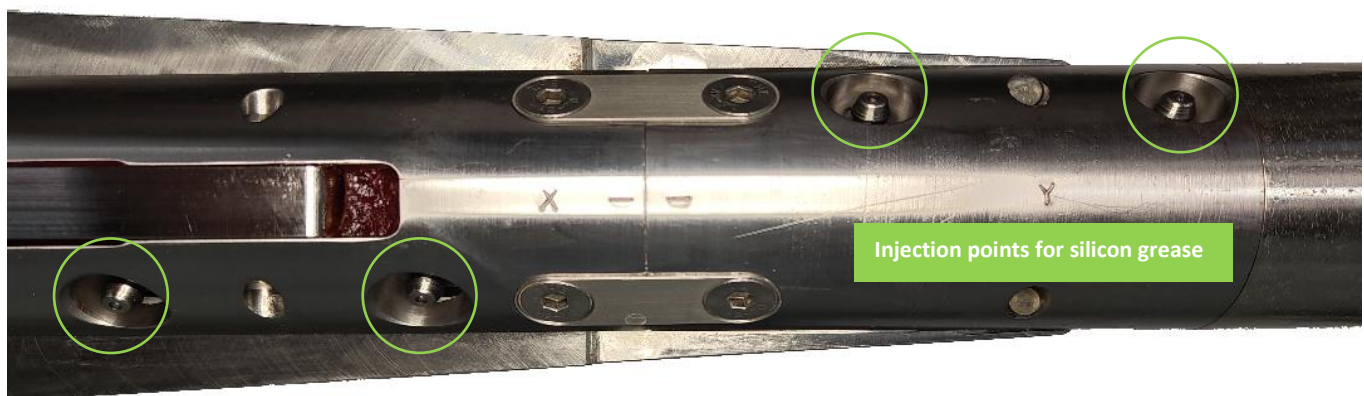


Figure 6-2 Caliper arm assembly - grease injection points

Press the nozzle head of the grease gun onto an injection point. Repeat the same operation at each injection point.

The QL40 tool joints require some maintenance. Make sure the threads on the brass threaded ring in the tool joints are free of sand mud or other dirt. We recommend a thin layer of anti-seize. When disassembling the sub string, dry the joint as it is separated to prevent fluid from entering the sub top and getting into the Lemo electrical connector inside.

Before the cable head is removed from the probe it is good to wash the probe with clean tap water and remove any sediments or grime that may have lodged itself in the caliper arms section. Alconox, or a mild soap and water may help remove oil, grease or other contaminants. You may scrub the surface of the housing with a brush, to remove any surface contaminants.

Inspect O-rings occasionally when breaking tool joint apart and keep the threads on both ends of the probe clean to minimize problems in the future.

NEVER take the probe apart.

This probe is very difficult to disassemble and requires special steps to be taken in order to gain access to the inside of the probe without damaging the electronics. If you have read this after attempting to disassemble the probe, chances are the probe has experienced damage and will need to be sent to the factory for repair.

Tools required:

- ✓ 1.5mm Hex Key
- ✓ 40-42mm spanner wrenches, Qty 2
- ✓ Paper towels or clean rags

Replacement Parts:

- ✓ ALT26005, Large Threaded Ring, Qty 2
- ✓ 28-174-995 M2x8 SHCS, Qty 2

6.1 Disassembly

Unscrew and remove the two M2x8 socket head cap screws and separate the two halves.

Four guide pins align the two ring halves and tend to hold them together after the screws are removed.

To pry the halves apart you can use a pair of spanner wrenches inserted into the wrench holes on opposite sides of the ring mating surfaces to pull them apart slightly (Figure 6-1.1).

Do this carefully to prevent bending the guide pins.



Figure 6-1.1 Disassembly of the threaded ring

Place something small in the opening and move the spanners to the other side and pry it open slightly.

This should be enough to release the two rings as shown below (Figure 6-1.2).



Figure 6-1.2 Ring halves when pulled apart

7 TROUBLESHOOTING

Observation	To Do
<i>Tool not listed in Tool panel drop down list.</i>	<ul style="list-style-type: none"> - Do you have a configuration file? - Has the configuration file been copied into the .../Tools folder (refer to Logger Suite manual about details of the directory structure)?
<i>Tool configuration error message when powering on the tool.</i>	<ul style="list-style-type: none"> - Check all connections. - Adjust the telemetry settings for your wireline configuration (see chapter 4.2 or 4.3) and store the new settings as default. Apply the appropriate tool settings for your logging run (see chapter 4.4).
<i>Tool panel - No current.</i>	<ul style="list-style-type: none"> - Verify that the wireline armour is connected to the logging system. Test your interface cable between winch and data acquisition system. - Verify cable head integrity. - Verify voltage output at the cable head (it should be 120V).
<i>Tool panel - Too much current (red area).</i>	<p>! Immediately switch off the tool !</p> <ul style="list-style-type: none"> - Possible shortcut (voltage down, current up): Check for water ingress and cable head integrity - wireline continuity. - Verify the interface cable between winch slip ring and data acquisition system is not loose at the connectors. Check for possible source of a shortcut. - If the above shows no issues, use test cable provided by ALT or MSI to verify tool functionality. - If the problem still occurs, please contact service center.
<i>Telemetry panel - status shows red.</i>	<ul style="list-style-type: none"> - Verify the telemetry settings for your wireline configuration (see chapter 4.2 or 4.3). - If problem cannot be resolved contact tech.support@mountsopris.com
<i>Telemetry panel - memory buffer shows 100%.</i>	<ul style="list-style-type: none"> - Indicates that the systems internal memory buffer is full. PC cannot receive incoming data streams fast enough. Ensure your PC has enough resources available.
<i>Telemetry panel – bandwidth usage shows 100%. (Overrun error message.)</i>	<ul style="list-style-type: none"> - Set the baudrate to highest value allowed by your wireline configuration. - Reduce logging speed or increase vertical sample step.
<i>Telemetry panel - many errors.</i>	<ul style="list-style-type: none"> - Verify the telemetry settings for your wireline configuration (see chapter 4.2 or 4.3). - Check bandwidth usage and telemetry error status.

Detailed part numbers and descriptions are available for tool delivery and spare part kits. Please contact tech.support@mountsopris.com for further details.